Computational Frontier

Community Planning Meeting Introduction Section

Frontier Conveners: Steve Gottlieb (Indiana University), Oli Gutsche (Fermilab), Benjamin Nachman (Berkeley Lab)

Topical Group Conveners: Wahid Bhimji (LBNL), Peter Boyle (BNL), Giuseppe Cerati (FNAL), Kyle Cranmer (NYU), Gavin Davies (Mississippi), Daniel Elvira (FNAL), Rob Gardner (UChicago), Katrin Heitmann (ANL), Mike Hildreth (Notre Dame), Walter Hopkins (ANL), Travis Humble (ORNL), Matias Carrasco Kind (Illinois/NCSA), Peter Onyisi (Texas), Gabe Perdue (FNAL), Ji Qiang (LBNL), Amy Roberts (Denver), Martin Savage (Washington), Phiala Shanahan (MIT), Kazu Terao (SLAC), Daniel Whiteson (Irvine), Frank Wuerthwein (UCSD)

DPF Core Principles and Community Guidelines (CP&CG)

- By participating in this meeting, you agree to adhere to the CP&CG
  - **Respect and support community members**
  - **Commit to constructive dialogue and take initiative**
  - Details of what this means, expectations for behavior, and accountability procedures are provided in the CP&CG document linked at: https://snowmass21.org/cpcg/start
- Everyone is invited to invoke the CP&CG as needed to encourage constructive and supportive collaboration
- The conveners of this meeting are your recommended first point of contact for reports of CP&CG violations occurring here
  - The conveners have received training in the CP&CG and how to handle reports
  - The CP&CG accountability procedure is designed to encourage early intervention and is flexible enough to appropriately address issues ranging from the discourteous to the egregious
  - Please do not hesitate to contact us!
- Snowmass is most successful when everyone's voice can be heard!

CompF01
Experimental Algorithm Parallelization

Giuseppe Cerati (FNAL), Katrin Heitmann (ANL), Walter Hopkins (ANL)

CompF02
Theory Calculations & Simulation

Peter Boyle (BNL), Daniel Elvira (FNAL), Ji Qiang (LBNL)

CompF03
Machine Learning

Phiala Shanahan (MIT), Kazu Terao (SLAC), Daniel Whiteson (Irvine)

CompF04
Storage and Processing Resource Access

(Facility and Infrastructure R&D)

Wahid Bhimji (NERSC), Rob Gardner (U. Chicago), Frank Würthwein (UCSD)

CompF05
End User Analysis

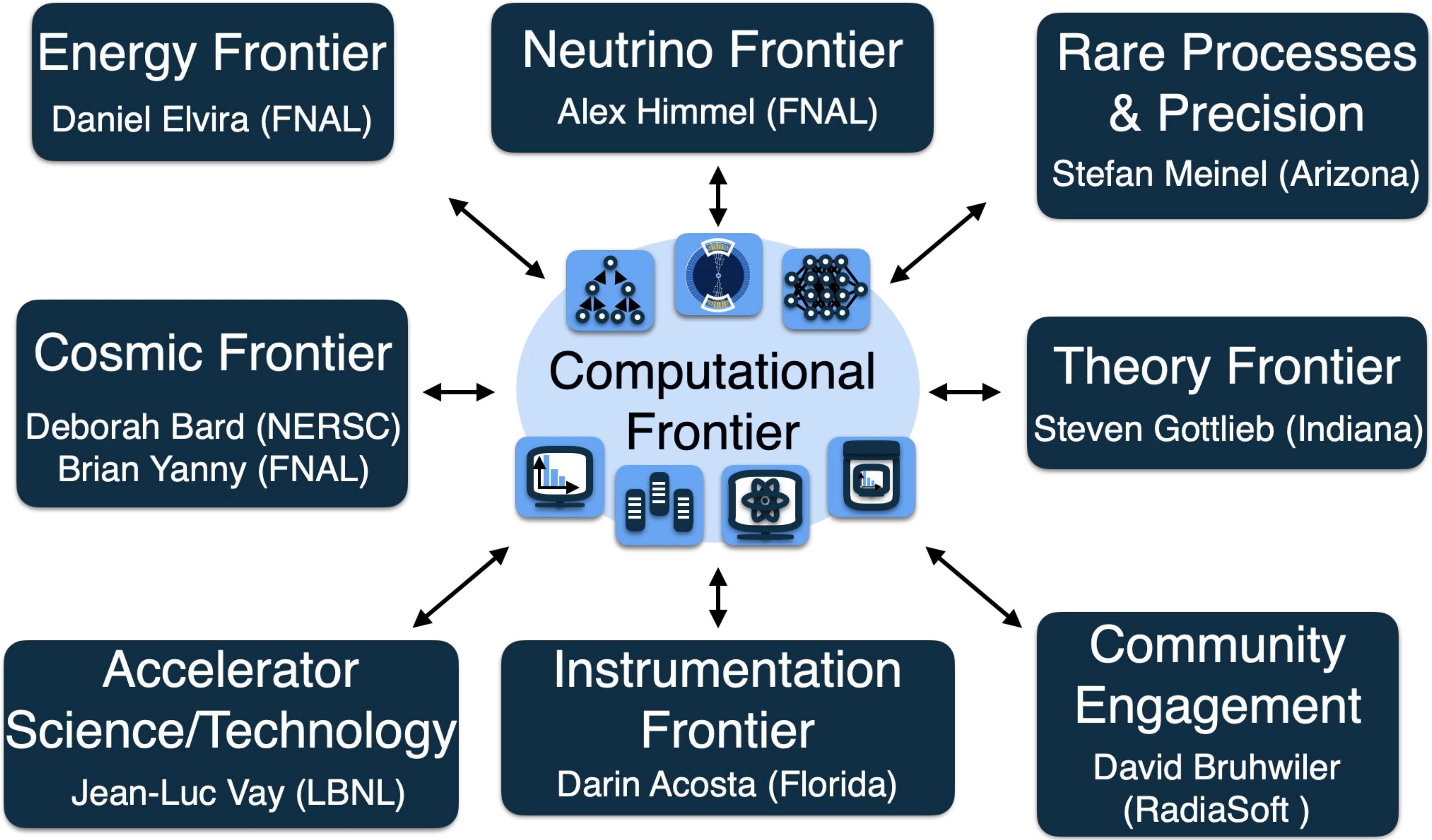
Gavin Davis (U. Mississippi), Peter Onyisi (U. Texas at Austin), Amy Roberts (UC Denver)

CompF06
Quantum Computing

Travis Humble (ORNL), Gabriel Perdue (FNAL), Martin Savage (U. Washington)

CompF07
Reinterpretation & Long-term Preservation of Data and Code

Kyle Cranmer (NYU), Mike Hildreth (Notre Dame), Matias Carrasco Kind (Illinois/NCSA)


Energy Frontier
Daniel Elvira (FNAL)
Neutrino Frontier
Alex Himmel (FNAL)
Rare Processes & Precision
Stefan Meinel (Arizona)
Cosmic Frontier
Deborah Bard (NERSC)
Brian Yanny (FNAL)
Computational Frontier
Theory Frontier
Steven Gottlieb (Indiana)
Accelerator Science/Technology
Jean-Luc Vay (LBNL)
Instrumentation Frontier
Darin Acosta (Florida)
Community Engagement
David Bruhwiler (RadiaSoft)

https://snowmass21.org/computational/start

SnowMass2021

- WELCOME PAGE
- ANNOUNCEMENTS
- SNOWMASS CALENDAR
- ETHICS GUIDELINES

- Organization

- SNOWMASS ADVISORY GROUP
- SNOWMASS STEERING GROUP
- FRONTIER CONVENERS

COMPUTATIONAL FRONTIER

Software and Computing are an integral part of the science process. High Energy Physics traditionally had the largest computing resource needs and subsequently most complex software stack in science. This is not true anymore, with many other science domains predicting equal or larger resource needs. The Computational Frontier will assess the software and computing needs of the High Energy Physics community emphasizing common needs and common solutions across the frontiers. We want to gain an overall understanding of the community's needs and discuss common solutions to them in the context of current and future solutions from the HEP community, other science disciplines and industry solutions. Our focus is to facilitate discussions amongst all frontiers and don't separate them into individual groups.

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Join our Slack channels!

- # comp_frontier_topics
- # compf01-expalgos
- # compf02-theorycalcsim
- # compf03-ml
- # compf04-storeandprocess
- # compf05-useranalysis
- # compf06-quantum
- # compf07-preservation

Join our topical group meetings!

indico

Join our email lists!

Topical groups

Name	Email List	Slack Channel
CompF1: Experimental Algorithm Parallelization	snowmass-compf01-expalgos[at]fnal.gov	#compf01-expalgos
CompF2: Theoretical Calculations and Simulation	snowmass-compf02-theorycalcsim[at]fnal.gov	#compf02-theorycalcsim
CompF3: Machine Learning	snowmass-compf03-ml[at]fnal.gov	#compf03-ml
CompF4: Storage and processing resource access (Facility and Infrastructure R&D)	snowmass-compf04-storeandprocess[at]fnal.gov	#compf04-storeandprocess
CompF5: End user analysis	snowmass-compf05-useranalysis[at]fnal.gov	#compf05-useranalysis
CompF6: Quantum computing	snowmass-compf06-quantum[at]fnal.gov	#compf06-quantum
CompF7: Reinterpretation and long-term preservation of data and code	snowmass-compf07-preservation[at]fnal.gov	#compf07-preservation

- Instructions to join a mailing list
- Instructions to join the Snowmass2021 Slack (at the end of the page)

Computational Frontier at the CPM

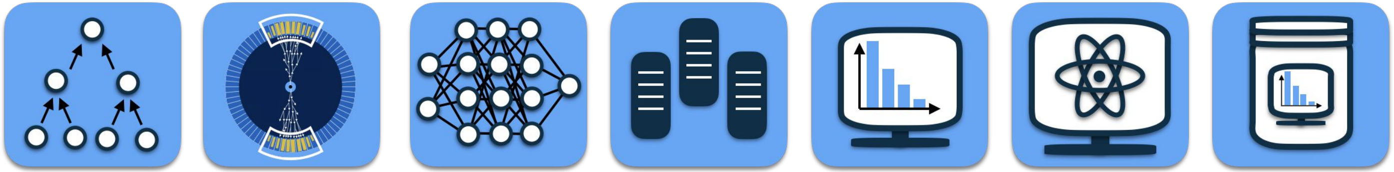
Breakout sessions are for cross-frontier coordination, finding out what other Frontiers' CompF needs are to do their science, and find out what CompF capabilities would enable more and better science.

CompF-related sessions:

- **Tuesday**: **Introduction and LOI overview**, then sessions with requested CompF participation: 125, 102, 118, 122, 124, 81, 128, 68, 80, 132, 64, 97, 123
- **Wednesday**: Sessions with requested CompF participation: 84, 28, 99, 119, then **CompF community planning session**

CompF community planning session on Wednesday starting at 2 PM central: go through outline of plan from Young Kee Kim's introduction slides and collect feedback from community. If time, discuss findings from break out session ➜ open style discussion with raising hands in Zoom

Goal for today: Go over the Letters of Interest submitted by the community for each topical group



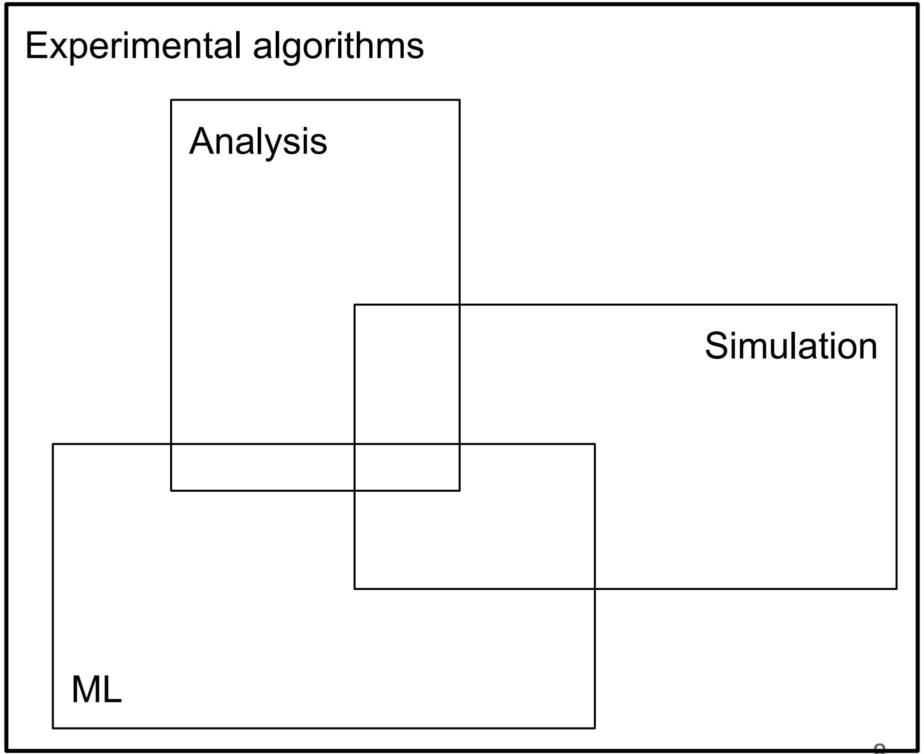
CompF01: Experimental Algorithm Parallelization

Background/Context/Physics:

The definition of “experimental algorithms” is broad, covering the topics of other WGs.

We’ll focus on the area not covered by others. It means central (i.e. not analysis specific), non-ML algorithms whose inputs are experimental data (both offline and software trigger).

This may have different meaning for different physics frontiers!
“Traditional reco” for collider community.



LOIs: CompF1 Experimental Algorithm Parallelization

1. **Reconstruction algorithms, parallelization and performance**
    a. Wire-Cell Toolkit (NF10, IF2)
    b. IceCube and IceCube-Gen2 Experimental Algorithm Parallelization (CompF2, CompF3)
    c. Particle tracking in CMS with mkFit: from Run3 to HL-LHC (EF0)
    d. Algorithmic Advances for Processing Data from Cosmological Surveys (CompF3)
2. **Portability and future resources**
    a. Portable Parallelization Strategies - a CCE project (CompF4, EF, NF)
    b. HEP reconstruction at HPC centers (CompF4, NF0)
    c. New Computing Model for Experiments Utilizing Large Scale LArTPCs (CompF4, NF)
3. **CompF1 as secondary (mostly simulation based LOIs)**
    a. Geant4 tasking, Geant4 optical photon simulation on GPUs, IceCube simulation, detector simulation on GPUs, LHC detector simulation on HPCs, FastSim for noble liquid detectors, accelerator simulations, Portable Solutions for ATLAS Simulation (**CompF2**)
    b. Measuring the energy spectra and composition of cosmic rays (**CF7,** EF6, EF7)
    c. HPC Facilities for Large Experiments: Opportunities and Challenges (**CompF4)**

CompF1: Common Trends

- New era with significantly more data.
- New resources (HPCs) that require rethinking/working of algorithms.

Word-cloud generated from LOIs that listed CompF1 as primary group. Word-cloud from all LOIs listing CompF1 highlighted the word “simulation” in addition.

CompF1: New/Noteworthy/Needs More Study

- Key technological challenge is the usage of new, more powerful and more diverse computing resources/architectures.
- Few examples of algorithms optimized for parallel execution: success stories, but required significant commitment from developers. Likely a path forward only for a small number of algorithms
- Portability tools promise to make this work easier, but there is not yet a clear choice in terms of which tool to use and performance portability still needs to be fully demonstrated
- Connections with other groups:
    - Many LOIs shared with simulation, likely connection in terms of a need for similar solutions
    - Connections with ML/Quantum as they target similar or complementary reconstruction steps
    - Connections with Facilities, to enable efficient usage of resources by algorithms

LOIs: CompF2 Theoretical Calculations & Simulation

Identified six domains - appointed contact people from volunteers pool

- Physics generators (3+11 LoIs): computing challenges for colliders, neutrinos
- Detector and beam simulation (11+2 LoIs): computing challenges and physics models related to interaction of particles with detectors in colliders, neutrinos, dark matter
- Cosmic simulation (2+16 LoIs): computing challenges and physics models related to structure formation, sky surveys, gravitational-wave detectors, fast prediction - emulators
- Theory (lattice) (5+34 LoIs): Hadron structure, flavor physics, ν-Nucleus scattering, BSM with LGT, computation and algorithms, Hamiltonian simulation, sign problem.
- Theory (perturbative)(0+10 LoIs): Precision loop calculations, computer algebra, phase space integration, conformal bootstrap, quantum computing.
- Particle accelerator modeling (17+2 LoIs): machine learning, conventional accelerators, advanced accelerator concepts, generic accelerator & beam simulation tools, standardization and practice, community organization, quantum computing

CompF2: Common Trends

- Improve/support essential packages: physics generators (Pythia, Sherpa, … , GENIE, NuWro, …), detector simulation toolkits (Geant4, FLUKA, MARS), cosmology - identified as core components of HEP program
- Faster generators and fast simulation techniques, including Machine Learning
- Engineering software to use accelerators (proliferation of GPUs, FPGAs)
- Performance & portability to and between HPCs
  - Many programming models and technologies, diverse hardware
- Software training, user support, career paths for software developers
  - Hiring and retention is a challenge

Connections with every CompF group and with all other frontiers: physics, software technologies, computer hardware, community tools and training

CompF2: New/Noteworthy/Needs More Study

- Some communities wrote vision, overarching LOIs on computing challenges (accelerator modeling, generators, detector simulation, cosmology, LQCD)
  - Good - collaboration is essential, cannot afford duplication
- Partnerships between the theory communities (HEP and Nuclear Physics) and experimentalists on physics models for generators and detector simulation
  - Underdeveloped in the case of nuclear physicists for detector simulation models
- Collaboration between HEP and computer scientists/applied mathematicians on code portability and optimization for new computer platforms
  - Exploiting the exascale era

Machine Learning Meets the Challenges of HEP Research and Development
Physics-based high-fidelity modeling of high brightness beam injectors
Composite Dark Matter from Strong Dynamics on the Lattice
Many-Body Effects in Axion Dark Matter Structure
A simulation program to discover dark matter physics in the sky
Small-scale structure at high redshift Lyman-alpha
The Vera C. Rubin Observatory as a Dark Matter
Novel Properties of Self-Interacting Dark Matter Halos
Dark Matter and Early Universe Physics from Measurements below the Galaxy Formation Threshold
Strong Lensing Probes of Dark Matter
Packed Ultra-wideband Mapping Array (PUMA) Science Opportunities
An Intelligent Platform for Theoretical Understandings
Cosmic dawn A probe of dark matter at small scales
A 21-cm based standard ruler at z ~ 20
Multi-Wavelength Simulations
IceCube and IceCube-Gen2 Experimental Algorithm
Portable Parallelization Strategies - a CCE project
A Parallel Poisson Solver Library for Accelerator
Simulations and Modeling for the Cosmic Frontier
End-to-End Virtual Accelerators (EVA
Center(s) for Accelerator and Beam Physics Modeling
A modular community ecosystem for multiphysics particle
Modeling of structured plasmas for next generation accelerators
Consortium for PIC Software in Accelerator Science
Numerical Modeling for Superconducting Accelerator Magnets
Chroma Photon Ray Tracer for Large-Scale Detectors
The GENIE neutrino event generator
Neutrino Event Generators
Lattice Calculation of Neutrino-Nucleon Cross Section
Lattice Calculation of Neutrino-Nucleon Cross Section

Interdisciplinary simulations Integrating accelerator RF and particle-matter interaction codes
Modeling Needs for Structure Wakefield
Simulations of Low-Energy Crystal Physics for Dark
Getting Ready in Algorithm and Software Development for the Arrival of the Quantum Computing Age
Electron Cooling Simulation Based on First
Computing Challenges for Event Generators
Embracing modern software tools and user-friendly practices
Surface Methods for Precision Accelerator Design and Virtual
Beam Dynamics Toolkit
IceCube and IceCube-Gen2 Simulation
Celeritas—a nascent GPU detector simulation code
High Energy Physics Simulations using HPCs
Fast Simulations for Noble Liquid Experiments
Simulating Optical Photons in HEP experiments on GPUs
Fast Multipole Method Approaches in Particle Accelerator
High Energy Physics Detector and Beamline Simulations in the 21st Century
Machine learning and surrogate models for simulation-based
Emerging Computational Techniques for Jet Physics
Pre-Learning a Geometry Using Machine Learning to
FPGA for HPC - exploring the possibilities of an alternative
Building Emulators for the Cosmic Frontier
Scientific AI Approaches in Computational Cosmology
cid4) (CompF2) Theoretical Calculations and Simulation [1–7
Develop/integrate data standards & start-to-end
Aspiration for Open Science in Accelerator & Beam Physics Modeling
Numerical relativity for next-generation
Cycle and symbiosis AI and Cosmology
Differentiable Simulators for HEP
The Future of Machine Learning in Rare Event Searches
Machine learning for sampling in lattice quantum field theory

IceCube and IceCube-Gen Quantum Computing
Front-form calculations on near-term and far-future quantum
Quantum Pattern Recognition for Tracking in High Energy Physics
Tensor Networks in High Energy Physics
Performance, Portability, and Preservability for Strong Dynamics at the Exascale
Particle Colliders with Ultra-Short Bunches
Long-lived charginos in the MSSM and beyond Thematic Areas (cid4) (EF08) BSM Model specific explora
Composite Higgs from Strong Dynamics on the Lattice
Probing Scalar and Tensor Interactions at the TeV Scale
Lattice-QCD Determinations of Quark Masses and the Strong Coupling αs
Precision Moments of Strange Parton Distribution Functions from Lattice QCD
The Femtography Project
Jet Physics at the Electron Ion Collider
Heavy Flavors at the EIC
Hadronic Tomography at the EIC and the Energy Frontier
Constraining Physics Beyond the Standard Model using Electric Dipole Moments
Fast optical photon transport at GEANT4 with Dual-Readout Calorimeter at future e+e− colliders
Connecting QCD to neutrino-nucleus scattering
Neutrino-induced Shallow- and Deep-Inelastic Scattering
Nucleon Form Factors for Neutrino Physics
Low-energy Inelastic Neutrino Cross Sections
Event Generators for Accelerator-Based Neutrino Experiments
Lattice-QCD Calculations Supporting Neutrino-Oscillation
Computing Neutrino Oscillations in Matter Efficiently
cid4) (RF1) Weak Decays of b and c Quarks

for RF1 Weak decays of b and c quarks
cid4) (RF1) Weak decays of b and c quarks
Precise Lattice QCD calculations of kaon and pion
High-precision determination of Vus and Vud from lattice QCD
Rare strange-to-down processes from lattice QCD
Discovering new physics in rare kaon decays
Using lattice QCD for the hadronic contributions to the muon g − 2
Calculations of nucleon electric dipole moments
Hadronic contributions to the anomalous
(NF2) Sterile neutrinos
Accelerator Probes of Millicharged Particles & Dark Matter
Light-front wavefunction from lattice QCD through large-momentum effective theory
Lattice field theory for conformal systems and beyond for TF03+TF05+CompF2
cid4) (CompF2) Theoretical Calculations and Simulation
Chiral Lattice Fermions and the Computational Frontier
Towards global fits of three-dimensional hadron structure from lattice QCD
Nuclear Matrix Elements for BSM Searches from Lattice QCD
The tensor renormalization group is poised for success
Lattice-QCD studies of inclusive B-meson decays
Multi-loop Amplitudes for Colliders
QCD and PRECISION PHYSICS
Advanced Germanium Detectors and Technologies for Underground Physics

LOIs: CompF3 Machine Learning

Physics specific ML (10+ LOIs)

Examples of applications (~20 LOIs)

ML Simulation (5 for fast sim, 3 for differentiable simulation)

Interpretability (6 for quantifying uncertainties, 7 for interpretation)

Community tools (4, specific tools/pipelines)

Resource needs (4, FPGAs, GPUs, TPUs, ASIC)

Education and community (4 for courses, 2 for open data, 1 for career tracks)

CompF3: Common Trends

Nearly all LOIs cross-listed with other areas.

Will gather a few example applications, ensure coverage from each frontier

No significant gaps identified

Considering a series of topical meetings, one per theme

- Connect groups with overlapping concepts,
- Show them how their work fits into our plan
- Encourage them to further develop for our context

CompF3: New/Noteworthy/Needs More Study

Needs study:

- Development of community tools/standards/ethical frameworks/open data formats for AI/ML research will need community-wide efforts and coordination

Noteworthy:

- Many parallels in physics-informed AI/ML efforts for theory and experiment
- Community includes both users of out-of-the-box ML, but also development of physics-informed AI/ML algorithms
- Resource needs for AI/ML are rapidly changing and developing, hard to estimate

LOIs: CompF4 Storage & Processing Resource Access

- 25 submissions total
  - 12 with CompF4 as lead
  - 8 as support (2-CompF1, 1-CompF2, 4-CompF5, 1-CompF7)
- Cross-listings (5)
  - IF4: Instrumentation Frontier, Trigger & DAQ
  - IF7: Instrumentation Frontier, Electronics/ASICs
  - NF1, NF6: Neutrino Frontier, Oscillations; Interaction and Cross Sections
  - TF5: Theory Frontier, Lattice QCD (2)

CompF4: Common Trends

Mapped roughly to sessions at August Workshop (link)

- Storage & Data Preservation (14,20,7,16)
- Analysis Facilities (18,17,13,19)
- Processing, HPC (9,12,2,5,8,11,1,4,23,3,25)
- AI Hardware (22,23,10,17)
- Edge Services / Interfaces / Integration (6,11)
- Networking (no LOIs)
- Covered by other frontiers or WGs (15,21,24)

CompF4: New/Noteworthy/Needs More Study

- There are many new and noteworthy ideas
  - Some of which were already discussed in the CompF4 parallel session at the Computational Frontier workshop earlier this summer.
  - Some of which came through via the LOIs
  - And some of which are being discussed in the parallel sessions this week:
    - 68 Computing in Cosmic Frontier
    - 80 Computing Requirements & Opportunities for the Energy Frontier
    - 81 Computing Requirements & Opportunities for the Neutrino Frontier
    - 123 Data Handling and AI/ML
    - 132 Collider Data Analysis Strategies

LOIs: CompF5 End User Analysis

24 Submissions

- 16 with CompF5 as main topical group
- 8 with CompF5 as subsidiary

Cross-groups:

- **CompF1, CompF2, CompF3, CompF4, CompF7**
- **CommF4**: Physics Education
    - Also got referrals to letters from **CommF2** (Careers) and **CommF3** (Diversity & Inclusion)
- **EF0**: Energy Frontier
- **CF1, CF4, CF5, CF6, CF7**: Dark Matter, Dark Energy: Cosmic Dawn, Modern Universe, Probe & Facility Complementarity, Cosmic Probes of Fundamental Physics
- **IF8, IF0**: Instrumentation Frontier
- **NF5, NF10**: Neutrino Frontier: Neutrino Properties, Neutrino Detectors

CompF5: Common Trends

End-user Training

Metadata

Interactive analysis workflows/https vs ssh access to clusters

Unprecedented data sizes will require new tools

Career Support

- All of the Analysis Facility letters highlighted the need for dedicated user-support staff as a way to ensure full use of Analysis Facility resources

CompF5: New/Noteworthy/Needs More Study

- Many letters identified modularity as a useful feature of analysis tools.
  - With so many new methods (machine learning, differentiable programming, etc.) this is likely to continue
- Many CommF4 letters point to training and documentation as necessary for an accessible Cosmic Frontier
- Cataloging common workflows to identify needs within and across disciplines would be useful for directing resources
- Cataloging expected data sizes for metadata and different analysis stages would help demonstrate clear need for new analysis tools, paradigms, and facilities
- Multiple experiments cited need for long-term data storage support for cross-experiment analysis and reproducibility

CF6: QIS in HEP - the “big picture” for HEP researchers

- Quantum information science (QIS) is new to Snowmass this year. We highly encourage everyone to look at the presentations from Session 102 to better understand how QIS and HEP fit together.
- Some key messages around QIS for the HEP researcher:
  - Quantum technology offers the potential to address science questions we care about deeply that we may not be able to address any other way.
  - Many of the core technologies and competencies in HEP enable our community to make unique and powerful contributions to QIS at the broadest scale.
  - There are significant new opportunities developing in QIS - we may participate fully in these opportunities without impacting the rest of the HEP agenda.
    - We are already making important progress on all three of these points, but it is crucial to effectively utilize the Snowmass process to organize our efforts in order to ensure long-term success.

LOIs: CompF6 Quantum Computing

- 41 Submissions total
  - 20 with CompF6 as lead
  - 21 with CompF6 as support
  - All responsive to topical area
- Cross-listings
  - TF10: Quantum Information Science
  - TF05: Lattice gauge theory
  - TF01: String theory, quantum gravity, black holes
  - TF07: Collider phenomenology
  - TF06: Theory techniques for precision physics
  - UF01: Underground Facilities for Neutrinos

CompF6: Common Trends

- Applications of Quantum Computing
  - Quantum Field Theory simulations (11)
  - Particle tracking and event reconstruction (7)
  - Quantum machine learning (3)
  - Tensor representations and methods (2)
- Infrastructure for Quantum Computing
  - Networks and sensors using quantum devices (7)
  - Tools and software to enable access to infrastructure (4)
  - Access to programmable quantum computers and simulators (2)
  - Ethics (1)

CompF6: New/Noteworthy/Needs More Study

- Intersection of QFTs, Tensor Structure, and QC
- Partnerships
- Workforce Development

LOIs: CompF7 Reinterpretation & long-term preservation...

19 submissions total

- 7 with CompF7 as primary
- +9 with CompF0-6 as primary
- 1 with CommF0 as primary
- 2 with IF8 as Primary

Connections to Energy, Cosmo, Neutrino, Rare Processes, Theory, and Accelerator Frontiers

CompF7: Common Trends

Increased emphasis on need for community (cyber) infrastructure:

- Explicitly recognize value in the combination of experimental data, simulated data, and synthesis of these ingredients
- Need for common repositories for data and analysis workflows + compute
- Need for “Gateways” tailored to a particular community’s use-cases
- Value in common code, standardization, and openness
- Several LOIs noted lack of investment in this infrastructure

This infrastructure is increasingly connected to analyzing the data.

Common themes: reinterpretation, workflows, sustainability, openness

- LOIs recognize challenges and opportunities

CompF7: Noteworthy Excerpts

There is a need within the cosmology community for a Cosmology Data Repository, which curates cosmologically useful datasets and simulations from across experiments and funding agencies, and co-locates these data at a computing center capable of jointly processing them. This would provide a method for archiving these datasets beyond the funding lifetime of individual projects, and, equally importantly, facilitate joint analyses of these data.

The Department of Energy (DOE), however, lacks a similar structure for curating data releases for DOE-funded cosmology experiments, as well as combining those data with external datasets for joint analysis. The

While data preservation has received community attention and is fairly well served in IceCube, software and analysis preservation are newer topics that we are only starting to acknowledge. IceCube is also working through the challenges of releasing the entire software chain as open source. This presents issues for an international organization, with contributions funded by agencies from different countries with differing licensing policies that are likely common to other large scientific collaborations.

We encourage the community to consider the development of centralized resources to enable long-term access to these data and analysis tools for the entire HEP community.

All of them require large computational effort to extract data, which has led to a proliferation of both open source and privately maintained code libraries, spanning a wide spectrum of available architectures and programming languages.

These issues will disproportionately affect early career researchers, who will predominantly be the ones to develop and maintain all software used in future experiments.

Abstract: CosmoSIS is a computational framework to organize and implement forward-modeling cosmological analysis that compares theoretical predictions to observational data.

This affects not only other experimentalists, but also theorists and phenomenologists who reanalyze, reinterpret, and corroborate experimental results.

Facilitating cosmic probes and dark matter searches with improved data access and software tools for multi-wavelength and multi-messenger analyses.

Analysis Description Language for Particle Physics

Numerical relativity for next-generation gravitational-wave probes of fundamental physics

Aspiration for Open Science in Accelerator & Beam Physics Modeling

Develop/integrate data standards & start-to-end workflows for Accelerator Physics

Digging for elusive BSM with simplified models

access to the dark matter scientific community, also making this data searchable, while respecting experiment Open Data Policies. The work within this TSP aims to include all the science data and digital objects (for example data management, metadata, reconstruction software, analysis pipelines, simulations...). The final output of each workflow will be individual experimental curves to be interpreted in terms of dark matter particle properties. The pipelines will also be designed so that they can ultimately automatically (re)produce this kind of plots with new models.

What next?

Please help us keep track of interesting and important discussions that happen during the CPM - we have prepared a Google doc that anyone should be able to edit:

https://docs.google.com/document/d/1Xa_mYki7SSbLzJc5I8eO9oprrgV6CVSgjgFArM1ewNM/edit?usp=sharing